clearly marked at Kiruna. For example, on the 7th of March, with low pressure, the isothermal zone was encountered at 8,000 meters; on the 26th, in a high pressure area, the isothermal zone began at 11,000 meters. As Mr. Rotch has recently found a similar variation in America at about 39° north latitude, this phenomenon may be assumed to prevail generally over the globe, at least outside of the Tropics.

4. The isothermal zone indicates the upper limit of the cyclonic disturbances of the atmosphere, which, in Lapland as well as in middle Europe, evidently do not extend higher than from 8,000 to 12,000 meters.

THE RAINFALL OF SOUTH AMERICA.[2]

This is the subject of an important memoir by E. L. Voss, formerly connected with the meteorological service of the State of São Paulo, Brazil, and the author of a well-known work on the climate of southern Brazil. For the past five years Doctor Voss has been diligently collecting the widely scattered literature of South American climatology, with a view to writing a memoir on the subject; but the work has proven so much heavier than he anticipated that he has found it advisable, for the present, to discuss the rainfall only.

The author tabulates and discusses data for 378 stations, giving the mean monthly and yearly amounts of rainfall and, for many stations, the probability of rainy days, maximum rainfall in twenty-four hours, duration of wet and dry periods, etc. This is the most important collection of rainfall data for South America that has yet been made, and will hereafter need to be included in every climatological library. The work is accompanied by a series of isohyetal charts, which would, perhaps, be easier to consult if they had been shaded to indicate the gradations of rainfall, instead of being printed in a number of distinct colors, having only an arbitrary relation to one another.

Doctor Voss has laid bibliographers and librarians under a heavy obligation by giving, at the close of his work, a critical annotated list of the principal publications relating to South American climatology. Much interesting information is also given regarding the development of the meteorological services in several South American states.

NOTES.

A list of the seismological stations of the world appears in the 1907-8 edition of Minerva, the invaluable "yearbook of the learned world" founded by the late Dr. Karl Trübner, of Strassburg. More than one hundred stations are enumerated.

"The artificial dispersion of fog" is the subject of a paper in the Scientific American Supplement of July 13, 1907, abstracted from the Bulletin des Ingénieurs Civils de France. The author, M. Dibos, describes experiments with two forms of apparatus, both of which appear to have been highly efficient. In the first, which is especially well suited for use on shipboard, a jet of hot air is projected into the fog in any desired direction, and produces a clear space 200 meters (656 feet) in length. In the second, Hertzian waves are used, with even better results. The author believes the latter form of apparatus would be very useful to navigation and on railroads. The Chemin de Fer du Nord has been much interested in his experiments and has installed experimental apparatus at its Paris terminal.

We learn from Nature of August 8, 1907, that the Scottish members of Parliament have requested a government grant for the purpose of reequipping and reopening the Ben Nevis observatories.

[2] Voss, Ernst Ludwig. Die Niederschlagsverhältnisse von Südamerika. Gotha: Justus Perthes. 1907. iv, 59 p. 4°. (Petermanns Mitteilungen. Ergänzungsheft Nr. 157.)

The latest annual report of the meteorological service of Ceylon (i. e., the meteorological branch of the surveyor-general's office) announced that a new astronomical and meteorological observatory was in course of erection at Colombo, and would probably be in working order by the end of 1907. Colombo is the central meteorological station of the island.

In the Annuaire de la Société Météorologique de France, Octobre, 1907, M. Chauveau reports a period of exceptional cold in the French Congo during July, 1907, the lowest temperatures generally occurring on the 18th. At Notre-Dame-des-trois-Épis (altitude 70 meters) a minimum of 13° C. (55.4° F.) was recorded, while at Brazzaville (altitude 320 meters) a temperature of 12.3° C. (54.1° F.) is reported to have occurred on the 19th. Both these readings, however, were possibly too low. The interesting feature of the report is the fact that widespread illness was caused among both the European and the native residents by a departure of only a few degrees from the usual temperatures of the season—a variation from normal conditions that would have past unnoticed in our latitudes.

The past year has witnessed the inauguration of two American periodicals devoted to aeronautics, viz, the American Magazine of Aeronautics, published in New York, and the American Aeronaut, published in St. Louis. Both are printed on good paper, illustrated with excellent half-tone plates, and edited in a conservative spirit. Several articles of meteorological interest have appeared in each.

TEMPERATURE COURSES.

By HENRY GAWTHROP. Dated Swarthmore, Pa., January 25, 1906.

There are three great temperature movements affecting the thermometers thruout the world, all closely recorded and arising from well-known causes: (1) the diurnal range between the extremes of night and day, (2) the annual seasonal changes, and (3) the nonperiodic temporary changes incident to the passing of the high and low barometric areas shown on the daily weather maps. The second of these is indicated by the normals established from the averaging, from long periods, of the daily means, and the third by the departures of the daily means from the daily normal.

I wish to call attention to a fourth great movement of temperature, as it is quite manifest to the industrial interests of the country. It is that which brings us a warm or cold winter or summer and a late or early spring or autumn. The contrast between this winter (1905-6) and that of a year ago (1904-5) may be cited—in the one case (1905-6) an open winter, with little snow and rivers free from ice, and in the other (1904-5) deep snow and great frost. This present paper is written to explain a method for measuring these great general departures, or long enduring departures, from normal temperatures.

These movements of temperature are masked much as is the tide in mid-ocean to the mariner, who can see only the waves. Yet if he could have a measure of the wave levels, above or below the general sea level, an average of such measurements would give him the tide level; and if he had this datum from points covering a vast extent of the ocean he would know of the general movement of the tides. As applicable to the motion of mercury in the thermometers this illustration is close, the daily departures being the waves and the daily normals the datum planes. We have the temperature measurements, and by eliminating the *waves* we can, I believe, determine what may well be called the temperature *tide* or *course*.

The difference between the mean temperature of a month and the normal of the month shows the departure of temperature for the month. Now if this is a good rule for the thirty days of the calendar month then it should be good for a

30-day period one day later; and, again, for another 30-day period one day later yet, and thus continuously. As a result we have progressive means and progressive departures showing the general course of temperature at a station.

To illustrate this method graphically the cold winter and early spring of 1904–5 are selected and the courses of temperature shown in fig. 1.

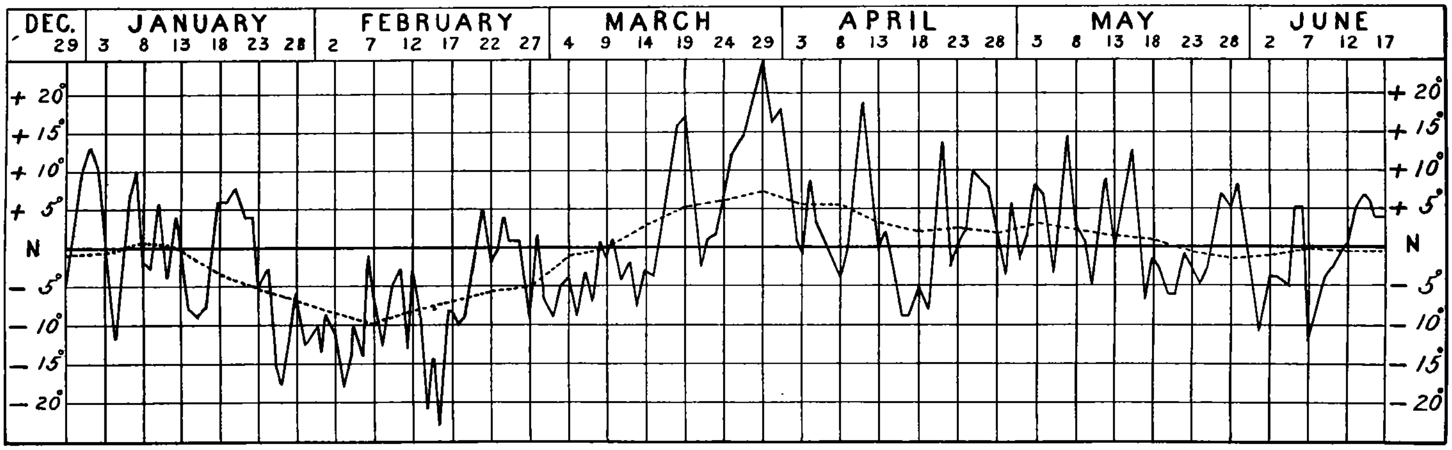

FIG. 1.—Temperature departures at Philadelphia, Pa., December, 1904, to June, 1905; continuous line, daily departures; dotted line, departure of the progressive 30-day mean.

The heaviest horizontal line, marked NN, represents the daily normal or average temperature. The scale of departures is given at the sides of the figure. The unbroken zigzag line connects the points representing the daily departures plotted to scale. The progressive departures, or the departures of the 30-day means, are plotted for each 5-day interval, for the central date, on the dates represented by the vertical lines. The dotted line connects the points thus plotted. Values might be computed and points plotted for each day, but the general course of the connecting line would not be different. Trifling irregularities would be introduced.

These wide departures of the 30-day averages of last winter and spring (1904–5) shown in fig. 1 are the most striking at Philadelphia in recent years. The cold period reached an extreme departure of —9.8° for the thirty days of which February 7 was midway. The normal was crost March 9 and a maximum positive departure reached (midway of thirty days) on March 29, 7.5°. The normal was crost again May 21, 1905.

TABLE 1.—*Departures of the 30-day means of temperature (Fahrenheit) at Philadelphia during 1903–4 and 1905–6.*

Date.	1903–4.	1905–6.	Date.	1903–4.	1905–6.
	°	°		°	°
October 25	+ 1.5	+ 0.1	January 8	— 6.5	....
October 30	+ 1.3	— 0.9	January 13	— 6.2	....
November 4	+ 1.0	— 2.3	January 18	— 5.8	....
November 9	+ 0.6	— 1.2	January 23	— 3.1	....
November 14	— 1.0	+ 1.2	January 28	— 4.4	....
November 19	— 3.7	+ 1.8	February 2	— 5.9	....
November 24	— 3.3	+ 2.1	February 7	— 6.7	....
November 29	— 4.4	+ 3.3	February 12	— 6.6	....
December 4	— 5.8	+ 3.2	February 17	— 5.7	....
December 9	— 4.5	+ 4.3	February 22	— 5.5	....
December 14	— 3.6	+ 3.5	February 27	— 5.0	....
December 19	— 4.6	+ 4.0	March 4	— 2.8	....
December 24	— 6.7	+ 4.9	March 9	— 0.7	....
December 29	— 6.3	+ 4.4	March 14	+ 0.4	....
January 3	— 5.7	+ 5.8	March 19	+ 0.3	....

Table 1 shows the contrast between the winters 1903–4 and 1905–6, in regard to these 30-day means. Each mean is an average of the daily departures for fifteen days before and fifteen days after the date. For instance, the departure entered December 4, +3.2°, is the average of the daily departures from November 20 to December 19, inclusive, and so on for the other dates. In the course for 1903–4 the normal was crost from warm to cold on November 11 and back again to warm on March 12, a course of one hundred and twenty-one days. The course now running (January, 1906) crost the normal on November 11 also, but this time from cold to warm.

The courses at many stations must be combined to find a full measure of the great thermometric "areas," which so vary our seasons. In Table 2 is shown the general movement for the record warm winter of 1889–90. Four stations—Alpena, Indianapolis, Memphis, and Galveston—are selected to compare with Philadelphia. It is evident that the movement extended far north into Canada, and far over the Gulf. From a record made in daily progression I note that while at Philadelphia the normal was crost from cold to warm on October 30, the change occurred at Alpena on November 6, at Indianapolis and Memphis on November 21, and at Galveston on November 23—some two weeks later than at the lake station.

TABLE 2.—*Departures of the 30-day means of temperature at seven stations for the winter of 1889–90, in degrees Fahrenheit.*

Middle day of period.	Philadelphia, Pa.	Galveston, Tex.	Memphis, Tenn.	Indianapolis, Ind.	Alpena, Mich.	San Diego, Cal.	Olympia, Wash.
1889.	°	°	°	°	°	°	°
October 25	— 1.1	— 1.4	— 0.3	— 2.9	— 2.1	+ 2.5	+ 1.8
October 30	+ 0.3	— 2.6	— 1.7	— 2.8	— 1.1	+ 2.9	+ 1.8
November 4	+ 0.2	— 2.5	— 2.3	— 3.4	— 1.5	+ 2.9	+ 1.3
November 9	+ 2.1	— 2.5	— 1.8	— 1.6	+ 1.7	+ 2.4	+ 0.2
November 14	+ 3.2	— 1.7	— 0.2	+ 0.5	+ 2.6	+ 2.6	+ 0.7
November 19	+ 3.2	— 1.7	— 0.8	— 0.2	+ 2.0	+ 2.7	— 0.2
November 24	+ 2.9	+ 0.9	+ 2.5	+ 2.8	+ 2.7	+ 2.8	— 0.1
November 29	+ 4.6	+ 3.6	+ 6.5	+ 5.2	+ 3.7	+ 2.6	— 1.2
December 4	+ 5.5	+ 6.2	+11.5	+ 9.3	+ 6.1	+ 2.7	— 1.5
December 9	+ 6.8	+ 7.7	+13.4	+10.4	+ 6.2	+ 2.3	— 2.0
December 14	+ 8.8	+ 9.7	+17.7	+12.9	+ 7.6	+ 1.6	— 4.0
December 19	+10.0	+11.0	+19.1	+14.8	+ 9.2	+ 0.6	— 5.5
December 24	+12.9	+12.9	+20.3	+15.5	+ 9.6	— 0.3	— 7.5
December 29	+12.3	+14.3	+21.1	+16.6	+ 9.3	— 1.6	— 7.4
1890.							
January 3	+13.5	+12.4	+16.7	+12.7	+ 7.6	— 2.4	— 7.3
January 8	+11.8	+11.8	+14.0	+10.1	+ 6.1	....	....
January 13	+10.4	+10.6	+10.5	+ 7.6	+ 5.8	....	....
January 18	+10.3	+11.4	+10.4	+ 8.1	+ 6.2	....	....
January 23	+ 9.8	+10.7	+ 9.4	+ 8.3	+ 6.8	....	....
January 28	+ 8.3	+ 7.8	+ 5.1	+ 4.4	+ 6.4	....	....
February 2	+ 7.9	+ 8.2	+ 6.4	+ 6.1	+ 8.0	....	....
February 7	+ 8.0	+ 8.2	+ 7.3	+ 7.0	+ 7.5	....	....
February 12	+ 8.0	+ 8.5	+ 7.7	+ 7.4	+ 7.7	....	....
February 17	+ 6.1	+ 4.3	+ 3.6	+ 3.2	+ 4.4	....	....
February 22	+ 2.4	+ 0.6	— 1.3	— 2.1	— 0.1	....	....
February 27	+ 3.5	+ 0.3	— 0.8	— 1.4	+ 0.6	....	....
March 4	+ 1.7	— 0.5	— 2.2	— 4.1	— 0.9	....	....
March 9	+ 1.5	— 1.1	— 2.2	— 3.2	+ 0.3	....	....
March 14	+ 1.1	— 2.2	— 2.7	— 3.5	— 0.7	....	....
March 19	+ 0.4	+ 0.1	— 1.0	— 2.4	+ 0.2	....	....

However, on the Pacific coast, during the approach of winter, the changes were almost the reverse of those at the central and eastern stations, as the two right-hand columns of Table 2 indicate.

The crest of the tide of warmth, so far as the five central and eastern stations are concerned, was at Memphis on December 29, 1889, with a 30-day departure of 21.1°; on the same day at Galveston and Indianapolis; on December 22 at Alpena, and on January 1, 1890, at Philadelphia.

As a rule, these courses of temperature pass off as deliberately as they come. The normal at Philadelphia was reached on March 17, 1890, and was crost at Alpena February 21; at Indianapolis and Memphis, February 20, and at Galveston, February 28.

These notes are suggestive of what might be found if a similar showing could be made for many stations. These large temperature movements do not fit to seasons as might be inferred from the cases cited. In the five years 1901–5 at Philadelphia there were sixteen courses of temperature having 30-day departures of 3° or more. The extremes were reached in eight different months.

It is evident that until the tides of the ocean had been observed by tide gages and the general movement measured no connection with the moon could have been traced. My belief is that we can not hope to discover the cause for our abnormal seasons until the departures from average seasons are measured.

SEASONAL DEPARTURES OF TEMPERATURE AT PHILADELPHIA, PA., DURING THE LAST TWENTY YEARS.

By HENRY GAWTHROP Dated Swarthmore, Pa., February 6, 1908.

On April 22 and October 22 the average of the day's mean temperature is the same as the average mean temperature for the year, and (at Philadelphia) these dates of equi-temperatures are midway between the coldest and warmest days of the year.

From the Philadelphia daily newspapers of January 1, April 23, and October 23, I have taken the accumulated departures of temperature; these data are all that is necessary to find the departures for the half-years shown in Table 1.

TABLE 1.—*Accumulated seasonal departures of temperature at Philadelphia, Pa.*

Years.	Summer half-year. (April 23–October 22.) Excess. (+)	Summer half-year. Deficiency. (−)	Years.	Winter half-year. (October 23–April 22.) Excess. (+)	Winter half-year. Deficiency. (−)
	°	°		°	°
1887	159		1887–1888		127
1888		353	1888–1889	396	
1889		26	1889–1890	951	
1890	93		1890–1891	234	
1891	27		1891–1892		17
1892	109		1892–1893		442
1893		11	1893–1894	292	
1894	177		1894–1895		338
1895	139		1895–1896	125	
1896	112		1896–1897	287	
1897	123		1897–1898	572	
1898	367		1898–1899		53
1899	131		1899–1900	258	
1900	632		1900–1901	220	
1901	286		1901–1902	63	
1902	50		1902–1903	648	
1903	10		1903–1904		578
1904	49		1904–1905		363
1905	213		1905–1906	404	
1906	314		1906–1907	3	
Sum	2,991	390	Sum	4,453	1,918

I note that there have been thirty periods of excess and ten of deficiency. The former foot up 7444° and the latter 2308°. The latest table of normals is, I believe, for about thirty-five years, so that these figures indicate that the first sixteen years must have had cold times to balance these warm years.

It is just possible that these dates of equi-temperatures might, by use, become as well established in the popular mind as the equinoctial was in the past generation. From October 23 to April 22, moreover, is approximately the period of furnace fires, and the accumulation of departures would appeal to the housekeeper.

It is also of interest to divide into three-month periods, for example:

October 23 to January 22.		January 23 to April 22.	
1904–5	−210°	1905	−153°
1905–6	+275°	1906	+129°
1906–7	+264°	1907	−261°
1907–8	+268°		

These periods of half and quarter temperature years are interesting for comparison, but are not the measure of the course of temperature desired. With the more exact measurement and the comparisons between many stations the evident great movements of temperature could be ascertained both as to area covered and their coming and going.

ELECTRIC DISTURBANCES AND PERILS ON MOUNTAIN TOPS.

By PROF. J. E. CHURCH, jr., Reno, Nev.
[Communicated January 11, 1908, by PROF. ALEXANDER G. MCADIE.]

In view of the scientific interest that has been aroused by the sudden death of mountaineers on the widely separated peaks of San Gorgonio and Whitney, during apparently the same electrical storm, in July, 1904,[1] the following recent experience of Capt. R. M. Brambila, U. S. Infantry, and the writer, will be welcomed as furnishing some hint of the power and magnitude of such electric disturbances. This experience was endured by the party during the regular visit to the automatic weather observatory maintained by the Nevada Agricultural Experiment Station on Mount Rose (altitude 10,800 feet), the dominating peak north of Lake Tahoe, on the California–Nevada State line, approximately 200 miles north of Mount Whitney.

The storm, which was mainly electric in nature, displayed itself first on the evening of Friday, October 19, 1907, in a heavy cloud mass lying close along the Carson Range, north of Mount Rose, but in no wise involving it. The flashes of lightning were frequent and heavy. Little thunder, however, if any, was heard. On the morning of the 20th, when the actual ascent of Mount Rose began, clouds gathered from the direction of Lake Tahoe about the summit, and enveloped it somewhat persistently during the day. The wind did not exceed 10 miles per hour, and the temperature remained above freezing.

From the summit itself the canyons below could be seen filled with masses of vapor. As night darkened a moderate storm of hail and snow with rain began to fall. The pack horse, which had been stabled on a terrace just below the observatory, was covered from tail to ears to protect him from the pelting missiles.

Then the electric display began, first as dull detonations to the south, and after an interval a flash at the observatory window, as if there were wires in the observatory and electricity had struck them. To this we paid little heed, for the occur-

[1] The distance between these peaks, which lie on opposite sides of the Mojave Desert, southern California, is approximately 180 miles, and the difference in elevation is 5,000 feet, the higher peak, Mount Whitney (altitude 14,499 feet [Gannett's Dictionary of Altitudes, fourth edition, gives 14,502]), being the highest mountain in the United States, excluding Alaska.

The death on San Gorgonio, said to be the first case of the kind in San Bernardino County, occurred July 24, 1904; that on Mount Whitney two days later, July 26. Referring to these fatalities Prof. Alexander G. McAdie, quoted in the Monthly Weather Review, September, 1904, page 420, says:

"The accidents have a scientific interest in that there are but few records of deaths by lightning in this State. But it should be noted that comparatively few people have been exposed to storms at high elevations. Mr. Byrd Surby was killed on the summit of Mount Whitney, within 50 feet of the monument. It was snowing at the time of the accident. It is probably not well known that the variations in the electrical potential of the air during a snowstorm are almost as rapid and as great as those prevailing during a thunderstorm. In this present case I am inclined to think that the electrical disturbance was not localized, but simply incidental to a disturbed field which extended well over the high Sierra, Inyo, Panamaint, and Telescope ranges; also the San Bernardino Range, and probably the mountains of Arizona. This condition lasted perhaps a fortnight."